WE CLAIM:

1. A motion estimation method for estimating a motion vector between a reference image frame and a current image frame, each of said reference frame and said current frame being formed by a plurality of pixels, the method comprising the steps of:

(a1) dividing a plurality of reference macroblocks each comprising a plurality of adjacent pixels within said reference frame, a set of said reference macroblocks forming a search range;

(a2) dividing at least one current macroblock comprising a plurality of continuous pixels from said current frame, each of said reference macroblocks and said at least one current macroblock having generally the same size and shape with corresponding pixel distribution;

(a3) determining a similarity of one of said reference macroblocks and a selected one of said at least one current macroblock based on averages of every two adjacent pixels as a pixel unit in said selected current macroblock and said reference macroblocks;

(a4) repeating step (a3) for all of said reference macroblocks in said search range; and

(a5) determining a motion estimation of said current frame and said reference frame based on said respectively determined similarity in steps (a3) and (a4).

2. The method of claim 1 further comprising the steps of:

calculating an absolute difference of a pixel unit for every two adjacent pixels in said current macroblock and a corresponding pixel unit for every two adjacent pixels in said reference macroblocks resulting in a plurality of calculated absolute differences; and

summing said calculated absolute differences for all of said pixel units of said current macroblock.

3. The method of claim 2 further comprising the step of determining a motion estimation vector between said selected current macroblock and one of said reference macroblocks within said search range having a smallest sum of said calculated absolute differences with said current macroblock.

4. The method of claim 1 further comprising the steps of:

calculating a square difference of a pixel unit for every two adjacent pixels in selected said current macroblock and a corresponding pixel unit for every two adjacent pixels in said reference macroblocks resulting in a plurality of calculated square differences; and

summing said calculated square differences for all of said pixel units of said current macroblock.

5. The method of claim 4 further comprising the step of determining a motion estimation vector between said current macroblock and one of said reference macroblocks within said search range having a smallest sum of said calculated square differences with said current macroblock.

6. The method of claim 1 further comprising the steps of:

multiplying a pixel unit for every two adjacent pixels in said current macroblock with a corresponding pixel unit for every two adjacent pixels in said reference macroblocksresulting in a plurality of multiplying values; and

summing all said multiplying values for all of said pixel units in said selected current macroblock.

7. The method of claim 6 further comprises a step of determining a motion estimation vector between said selected current macroblock and

one of said reference macroblocks within said search range having a largest sum of said multiplying values.

8. A motion estimation method for estimating a motion vector between a reference image frame and a current image frame, each of said reference frame and said current frame being formed by a plurality of pixels, the method comprising the steps of:

(b1) dividing a plurality of reference macroblocks each comprising a plurality of adjacent pixels within said reference frame, a set of said plurality of reference macroblocks forming a search range;

(b2) dividing a current macroblock comprising a plurality of continuous pixels from said current frame, each of said reference macroblocks and said current macroblock having generally the same size and shape with corresponding pixel distribution;

(b3) determining a similarity of one of said reference macroblocks and said current macroblock based on averages of every two adjacent pixels as a pixel unit in said current macroblock and a first determined set of said reference macroblocks;

(b4) determining similarities for said first predetermined set of reference macroblocks in said search range for performing a coarse tune operation;

(b5) determining a preferred reference macroblock from said first predetermined reference macroblocks based on said similarities;

(b6) determining similarities for a second predetermined set of reference macroblocks around said preferred reference macroblock based on pixels of said current macroblock and said second predetermined set of reference macroblocks for performing a fine tune operation; and

(b7) determining a motion estimation of said current frame and said reference frame from said determined similarities of in step (b6).

9. The method of claim 8 further comprising the steps of:

calculating an absolute difference of a pixel unit for every two adjacent pixels in said current macroblock and a corresponding pixel unit for every two adjacent pixels in said reference macroblocks resulting in a plurality of calculated absolute differences; and

summing said calculated absolute differences for all pixels of said current macroblock.

10. The method of claim 9 further comprising the step of determining a motion estimation vector between said current macroblock and one of said reference macroblocks within said first predetermined set of said reference macroblocks having a smallest sum of said calculated absolute differences.

11. The method of claim 8 further comprising the steps of:

calculating an absolute difference of a pixel of said current macroblock and a corresponding pixel of said reference macroblocks resulting in a plurality of calculated absolute differences; and

summing said calculated absolute differences for all pixels of said current macroblock.

12. The method of claim 11 further comprising the step of determining a motion estimation vector between said current macroblock and one of said reference macroblocks within said second predetermined set of said reference macroblocks having a smallest sum of said calculated absolute differences.

13. The method of claim 8, wherein the step (b3) further comprising the steps of:

calculating a square difference of a pixel unit for every two

adjacent pixels in said current macroblock and a corresponding pixel unit for every two adjacent pixels in said reference macroblocks resulting in a plurality of calculated square differences; and

summing said calculated square differences for all pixels in said current macroblock.

14. The method of claim 13 further comprising the step of determining a motion estimation vector between said current macroblock and one of said reference macroblocks within said first predetermined set of said reference macroblocks having a smallest sum of said calculated square differences.

15. The method of claim 8 further comprising the steps of:

calculating a square difference of a pixel of said current macroblock and a corresponding pixel of said reference macroblocks resulting in a plurality of calculated square differences; and

summing said calculated square differences for all pixels of said current macroblock.

16. The method of claim 11 further comprising the step of determining a motion estimation vector between said current macroblock and one of said reference macroblocks within said second predetermined set of said reference macroblocks having a smallest sum of said calculated square differences.

17. The method of claim 8 further comprising the steps of:

calculating a multiplying value of a pixel unit for every two adjacent pixels in said current macroblock and a corresponding pixel unit for every two adjacent pixels in said reference macroblocks resulting in a plurality of calculated multiplying values; and

summing said calculated multiplying values for all pixels of said current macroblock.

18. The method of claim 13 further comprising the step of determining a motion estimation vector between said current macroblock and one of said reference macroblocks within said first predetermined set of said reference macroblocks having a largest sum of said calculated multiplying values.

19. The method of claim 8 further comprising the steps of:

calculating a multiplying value of a pixel of said current macroblock and a corresponding pixel of said reference macroblocks resulting in a plurality of calculated multiplying values; and

summing said calculated multiplying values for all pixels of said current macroblock.

20. The method of claim 11 further comprising the step of determining a motion estimation vector between said current macroblock and one of said reference macroblocks within said second predetermined set of said reference macroblocks having a smallest sum of said calculated multiplying values.

21. The method of claim 1 wherein said reference frame and said current frame are formed by even lines and odd lines.

22. The method of claim 21 further comprising the step of determining a top field motion estimation using pixels in said even lines.

23. The method of claim 21 further comprising the step of determining a bottom field motion estimation using pixels in said odd

lines.

24. The method of claim 8 wherein said reference frame and said current frame are formed by even lines and odd lines.

25. The method of claim 24 further comprising the step of determining a top field motion estimation using pixels in said even lines.

26. The method of claim 24 further comprising the step of determining a bottom field motion estimation using pixels in said odd lines.

27. A motion estimation device for reducing memory output bandwidth comprising:

a memory having a frame buffer for storing a plurality of image frame data;

a controller being connected to said memory, said controller inputting and processing data of a current image frame and a reference image frame, and then outputting processed data;

a first motion estimation processor being connected to said controller for coarse-tuning motion estimation of said current frame to said reference frame based on said processed data input from said controller, and then outputting coarsed-tuned data; and

a second motion estimation processor being connected to said controller and said first motion estimation processor for fine-tuning motion estimation of said current frame to said reference frame based on said processed data input from said controller and said coarse-tuned data input from said first motion estimation processor.

28. The device of claim 27 wherein said controller dividing a

plurality of reference macroblocks each comprising a plurality of continuous pixels within said reference frame; said reference macroblocks forming a search range; and said controller dividing a current macroblock comprising a second plurality of continuous pixels from said current frame; wherein each of said reference macroblocks and said current macroblock has the same size and shape with corresponding pixel distribution.

29. The device of claim 28 wherein said first motion estimation processor determines a similarity of said reference macroblocks and said current macroblock based on averages of every two adjacent pixels in said reference macroblocks and said current macroblock.

30. The device of claim 28 wherein said second motion estimation processor determines a similarity of said reference macroblocks and said current macroblock based on every pixel in said reference macroblocks and said current macroblock.

31. The device of claim 30 wherein said controller sends a difference of every two adjacent pixels of said reference macroblocks and said current macroblock and a least significant bit of a sum of every two adjacent pixels of said reference macroblocks and said current macroblock to said second motion estimation processor.

32. The device of claim 27 wherein shapes of said reference macroblocks and said current macroblock are rectangular.

33. The device of claim 27 wherein said memory further comprises a dynamic random access memory (DRAM) and static dynamic random access memory (SDRAM).

34. A motion estimation method comprising the steps of:

(a) displaying an image in a plurality of frames corresponding to a plurality of time periods;

wherein each frame further comprises a given number of pixels, each pixel represented by two-dimensional abscissa and ordinate coordinates;

wherein each frame further comprises at least one macroblock having a lesser number of pixels than said given number of pixels of said frame;

wherein a current frame is one of said frames in a current time period of said plurality of time periods;

wherein said current frame further comprises at least one current macroblock having a lesser number of pixels than those of said current frame;

wherein a reference frame is one of said frames in a time period of said plurality of time periods prior to said current time period for said current frame;

wherein said reference frame further comprises at least one reference macroblock having a lesser number of pixels than those of said reference frame;

(b) averaging two adjacent pixels of said current macroblock;

(c) repeating step (b) for all pixels of said current macroblock;

(d) averaging two adjacent pixels of said reference macroblock;

(e) repeating step (d) for all pixels of said reference macroblock;

(f) subtracting said averaged pixels of said current macroblock from corresponding said averaged pixels of said reference macroblock resulting in a plurality of differences;

(g) taking a plurality of absolute values for said differences resulting in a plurality of absolutions;

(h) summing said absolutions resulting in a SAD (sum of absolutions of differences);

(i) shifting abscissa and ordinate coordinates of said reference macroblock by corresponding abscissa and ordinate shift values resulting in a shifted reference macroblock;

(j) averaging two adjacent pixels of said shifted reference macroblock;

(k) repeating step (j) for all pixels of said shifted reference macroblock;

(l) subtracting said averaged pixels of said current macroblock from corresponding said averaged pixels of said shifted reference macroblock resulting in an additional plurality of differences;

(m) taking an additional plurality of absolute values for said additional differences resulting in an additional plurality of absolutions;

(n) summing said additional absolutions resulting in an additional SAD (sum of absolutions of differences);

(o) repeating steps (i), (j), (k), (l), (m) and (n) resulting in a plurality of additional SADs; and

(p) taking a minimum SAD out of said SAD and said additional SADs.

35. The method of claim 34 further comprising the steps of:

restoring said two adjacent pixels of said current macroblock by:

summing first and second of said two adjacent pixels resulting in an adjacent sum;

subtracting said first pixel from said second pixel resulting in an adjacent difference;

wherein said first pixel is equal to:

(said adjacent sum + said adjacent difference)/2

wherein said second pixel is equal to:

(said adjacent sum – said adjacent difference)/2.

36. The method of claim 34 wherein said reference frame and said current frame are formed by even lines and odd lines.

37. The method of claim 36 further comprising the step of determining a top field motion estimation using pixels in said even lines.

38. The method of claim 36 further comprising the step of determining a bottom field motion estimation using pixels in said odd lines.